

GOAL 2: Facilitate Access to National and International Information Resources for Toxicology and Environmental Health

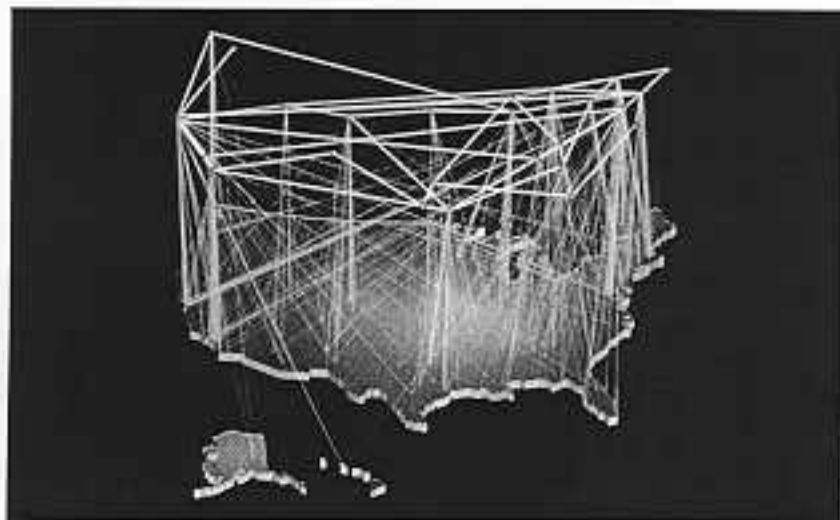
An important long-term goal for NLM has always been to facilitate access to toxicology and environmental health data and information that may not otherwise be easily available. To do this, NLM identifies such resources and makes them accessible either by linking them into networks, describing them in directories, or by establishing cooperative arrangements between NLM and providers of information. Perhaps in the future potential users may see an electronic composite or "seamless" system in which "intelligent" system agents guide the user query throughout all relevant parts of the composite network of linked (and mutually referential) knowledge sources.

2.1 Continue to Improve Access to Information Products and Services

For the MEDLARS files, NLM can point to great success with user-oriented information products and services, such as Grateful Med, the personal-computer-based front end searching package, and the recent development of Coach, an expert searcher system. Coach brings to bear the UMLS Metathesaurus and other knowledge sources to assist Grateful Med users seeking help in improving retrieval from MEDLARS. These interface programs have been shown to satisfy the needs of health professionals and also have been effective in outreach efforts focused on health professionals serving minority, rural, and other underserved populations. There is a need for similar advances for the toxicology and environmental health information resources.

Recommendation 2.1

NLM should focus attention on the ease with which end users can access toxicological and environmental health information. New computer and information science technologies such as intelligent electronic gateway systems and artificial intelligence should be thoroughly evaluated and exploited, and combined with the results of studies of user needs to improve user access.



The image represents the interconnected "backbone" networks of NSF, NASA, and DOE, together with selected client regional and campus-area networks. Nodes of the backbones are represented as connected spheres on a plane above the outline of the United States; the client networks are represented as dendritic lines from the backbone nodes to the geographic locations where the client networks attach.

2.2 Develop a Directory for Toxicology and Environmental Health Information Resources

Many of the databases in toxicology and environmental health are not NLM databases now, nor—for various reasons—are they likely to become part of the NLM dissemination systems in the future. Few of these databases were designed to serve a broad spectrum of users. Most were developed by individual organizations to meet their specific information needs. It is difficult for the user to identify appropriate databases to search for answers to specific questions and to learn how to extract information from those databases once identified. Some databases (such as files that contain confidential business information) are restricted in their use; others require significant training.

NLM could make an important contribution by developing, maintaining, and promoting a directory of databases in toxicology and environmental health—i.e., a system with “pointers” to available public and private resources. A properly designed directory would go a long way toward facilitating the use of toxicology and environmental health information by answering questions about where information can be found and how it can be accessed. Such a directory of databases could contain indications of the content of the database, characterizations of the data quality, and instructions on how to use the database. The directory is itself a database, and there are many possible formats for its delivery to users—electronic online access, CD-ROM, printed, and perhaps future forms such as computer knowledge sources, imbedded within software intelligent agents.

The Panel is aware of the current study being sponsored by the Federal Coordinating Council for Science Engineering and Technology (FCCSET) concerning the feasibility of building a comprehensive directory of databases that could be used as information resources for health and ecological risk assessment activities.⁵ Health risk assessment—the use of available information to evaluate and estimate exposure to a hazardous agent and its consequent adverse health effects—depends on the availability of accurate, up-to-date scientific information. Because risk assessment plays a significant role in Government regulatory priority setting and decision making, improving the process will provide better support for setting priorities both in the control of existing risks and in the development of new technologies with reduced risks.

A computer-based directory would permit the development of a number of access tools that would employ informatics, expert systems, and gateway technologies to reach and search selected databases. An expert system based on the data in the directory could be developed to help the non-initiated user find the pertinent sources to meet specific information needs. NLM research efforts in informatics could be brought to bear on this aspect of the directory. Another option would be a gateway network system that not only would tell the user where information could be found, but—when technically feasible—would connect the user directly to the systems to be accessed. If the target databases are not available online, the access system could help to generate a request to obtain the information.

Legislators and policy makers need better information to make good laws and regulations; public health officials need better information to detect and prevent the health effects of exposure; and the public deserves information that is understandable...⁶
(National Research Council)

The marshaling of resources, public and private, to insure better health for the American people has been a phenomenon of the post-World War II decades.... Attention has been called repeatedly to a significant exception to this commendable development. Those problems which are associated with the communication of new scientific knowledge, both to researchers who must use it still further to explore the unknown, and to practitioners who must have access to it to improve the Nation's health, are so critical as to warrant our most serious attention.⁶ (President's Commission on Heart, Cancer and Stroke)

Ultimately, such an electronic directory database could provide the foundation for a system that would integrate databases using distributed network technology to bring to the user the actual desired information, rather than just pointing to where it could be obtained.

Recommendation 2.2

NLM should develop a directory of existing and accessible toxicological and environmental health information resources, using online computer and other distribution means. The directory should serve as a locator tool and an electronic linkage among the principal databases. It should facilitate users' access to databases that may not otherwise be easily available, especially non-NLM databases. Such a directory of information resources, while a large undertaking, should have as one goal to be an essential tool for risk assessment activities in Government and industry. This major task should be undertaken by NLM in concert with a new user advisory group. An NLM effort in this area should be coordinated with other similar Federal efforts.

2.3 Develop the Information Sources Map as a Way to Implement the Directory for Toxicology and Environmental Health Information Resources

The Information Sources Map (ISM) component of NLM's Unified Medical

Language System is being developed as part of the Library's contribution to research in the national High Performance Computing and Communications project. The ISM appears to embody the functional goals of the toxicology directory; it provides both human and machine readable descriptive information on the content and access conditions for computerized information sources, and the ability to select information sources automatically based on the subject and type of information sought. The goal is to allow users to state simply what information is sought, to have the ISM determine likely sources for that information, and to retrieve it in a manner that does not require a user to learn the syntax or inner structure of the system being queried.

Prototype efforts to expand the number of information sources represented in the ISM currently include some that are relevant to toxicology and environmental health. Depending upon the financial resources that can be assigned to this activity, particular emphasis should be placed on databases supportive of health risk assessment activities.

Recommendation 2.3

As part of the High Performance Computing and Communications initiative, NLM should undertake further development of the Information Sources Map as a possible mechanism for implementing the directory for toxicology and environmental health information resources. Emphasis should be placed on databases supportive of health risk assessment activities.

2.4 Support Information Access for Emergency Preparedness and Response Programs

NLM's mandate to provide information support for health care includes the health-related aspects of emergencies. The ever-increasing likelihood of emergencies involving hazardous chemicals is forcing both the emergency management community and the health professions to reexamine how they can prevent, mitigate, or respond to such emergencies. One such incident is described in Figure 3.

NLM's TIP, with the Agency for Toxic Substances and Disease Registry (ATSDR), has built a portable, microcomputer-based workstation that provides information assistance to emergency response teams working on accidents involving hazardous chemicals. The prototype, known as ANSWER (an acronym for ATSDR/NLM's Workstation for Emergency Response), consists of software modules designed to facilitate easy access to information useful to response teams during emergencies. A graphic representation of the workstation is shown in Figure 2.

In 1991, the Workstation was made available for beta testing at 13 sites, including selected state health departments and several poison control centers. The results of the test show that ANSWER is fully functional in a command center environment in both emergency and nonemergency situations. Further, the test shows that chemical databases on CD-ROM in addition to the Hazardous Substances Data Base (HSDB) would be very helpful in the field.

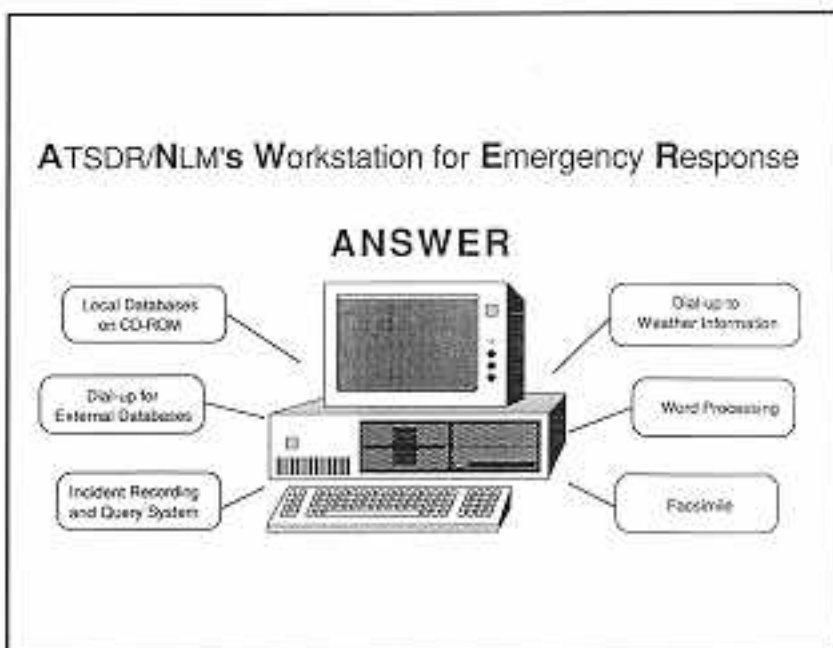
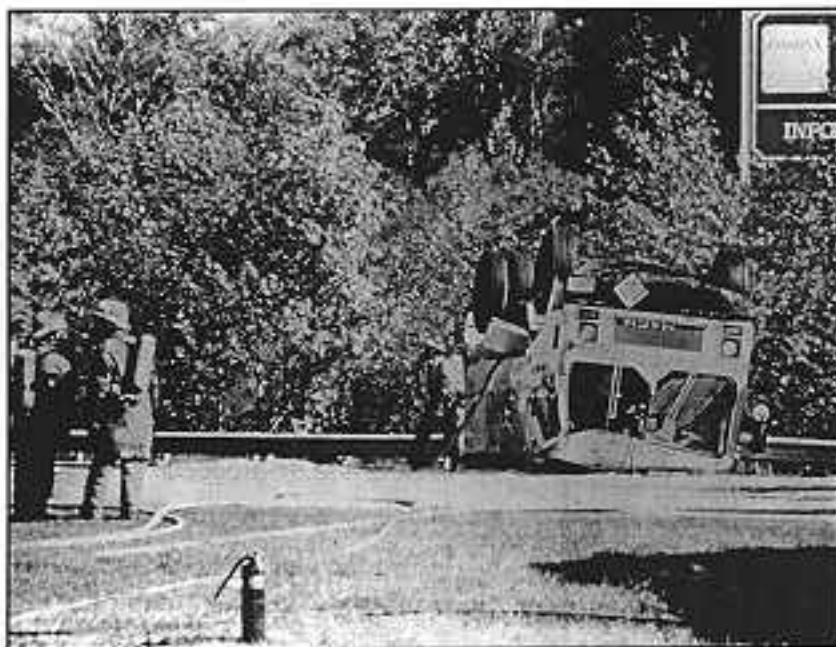


Figure 2



Emergency Response: A Quiet July Afternoon ⁷

DESCRIPTION: The time is 2:07 P.M. on the afternoon of July 18, 1985. It is a typical July afternoon in the Ohio River Valley. The temperature is in the high 80's, low 90's; the humidity is high and there is little if any air movement. The threat of an afternoon thunderstorm is present. Suddenly, the quiet of the afternoon is shattered by an explosion at a chemical manufacturing plant in southwest Jefferson County, Kentucky. A giant fireball erupts. Two welders who were on top of the tank are killed immediately; a third is thrown clear of the tank but suffers third degree burns over eighty percent of his body. An emergency call is placed to 911; the call is routed to the fire alarm office. Fire alarm personnel notify the volunteer fire protection district and activate the local hazardous material response team. Notification is then given to state response agencies.

THE FIRST AFTERNOON: 2:15P.M.: First on scene fire units are confronted with a fireball approximately 40 feet in height. Having been on the scene before, fire personnel recognize the fireball to be in the tank farm area of the facility. Located here are some 20 to 30 storage tanks averaging approximately 12,000 gallons capacity each. Plant personnel are not able to immediately advise as to the cause of the explosion or the materials involved. The principle product at this facility is a phenol-formaldehyde based resin. Upon entry to the explosion area, firefighters find a 16 foot high, 10 foot diameter tank which has been blown off its foundation. The liquid from within the tank is now burning within the diked area of the tank farm and impinging on other tanks. Plant personnel have started a water stream to cool other tanks and reduce the likelihood of further explosions. Fire personnel immediately begin to add additional cooling streams. The injured employee is taken by air ambulance to the trauma/adult burn center in downtown Louisville.

2:30P.M.: Hazardous material response units from the Health Department and other agencies begin to arrive. Facility personnel advised that the material is a phenol-formaldehyde resin in a methanol solvent. Surrounding tanks contain phenol, formaldehyde and methanol. The plant safety engineer advises that the by-products from the fire are unknown and could be hazardous. The plant manager advises that the materials are non-hazardous and that no special precautions need be taken. Haz-Mat personnel begin to research the product information in both written references and by computer hook-up to remote databases. Specific concerns include:

- Safety / protection of fire personnel involved in firefighting effort
- Protective actions necessary for citizens downwind from event
- Treatment necessary for injured and contaminated worker
- Control of potential contamination spread to air ambulance and hospital
- Identification of special land uses downwind (i.e.: schools, nursing homes)

Information needs identified include:

- Physical, chemical and health hazards of non-combusted materials and of combustion by-products
- Meteorological information
- Land uses and populations within a one mile radius
- Inventory of all plant materials

2:40P.M.: Precautionary evacuation of surrounding area (approximately 150 persons) is begun by law enforcement personnel. Firefighting and tank cooling efforts continue. Additional response units from state and local agencies continue to arrive. Data hook-ups are established to access remote hazardous material databases. An on-site meteorology station is erected. Information collected is used to predict possible path of the plume.

3:30P.M.: The fire has been put out but cooling streams continue. Firefighters begin to complain of headaches and other physical problems that could be related to either product exposure or heat stress. Local elected officials arrive at the scene to assess damage and are taken on a tour by the plant manager. Information received from databases, etc. is sent to hospital and shared with regional poison control center. No information on product mixture or combustion by-products can be found (a MSDS is available but lacks any specific treatment information beyond the first aid level).

5:00P.M.: Decision is made to lift the evacuation request and allow persons to return to their homes. Shortly after decision is made, another fire breaks out in general area of tanks. Decision is rescinded and evacuation put back into place.

6:00P.M.: Second fire is put out and evacuation is lifted.

10:00P.M.: Fire department representatives contact the health department regarding decontamination/disposal of contaminated fire gear that was taken from the scene. Fire service advised to bag materials and await outcome of next day investigation.

THE SECOND DAY: Residents upwind from the site but impacted by the blast and the evacuation begin to ask questions regarding fitness for consumption of products grown in their gardens. Residents are advised that based on the information available, fruits and vegetables that can be washed should be OK. Industry representative requests that all response personnel, including local elected officials, report to local hospital for "blood tests". This raises significant questions among responders as to the actual potential for long term health effects. Fire, police, some emergency medical service personnel and local elected official go to hospital for "blood test". Director of health asked to explain why this is necessary and what is expected outcome. Industry representatives request that all potentially contaminated clothing and equipment be bagged and returned to the plant for decontamination and or disposal. Third worker who was injured in original explosion and fire dies.

TWO WEEKS LATER: Citizens still expressing concerns about crops. Some plants are turning brown and dying. The county agricultural agent is requested to survey the area. He does so but is not able to make a definitive statement as to cause of plants dying. State special agent for plant pathology is brought in to survey area in question. All problems can be explained by normal insect, plant disease and ozone damage (Jefferson County had been under an ozone warning approximately two weeks before the explosion).

*Figure 3.
Planning Panel on
Toxicology and
Environmental
Health,
March 24, 1992,
Clark Bledsoe*

Other information resources for emergency preparedness and response are available, including Materials Safety Data Sheets, TOMES, EIS, and CAMEO (see glossary). These systems contain information about such areas as facility site plans, maps and geographic data, health care facilities, plume dispersion models, chemical inventories, and medical management of chemical exposures, and have the capacity for presenting dynamic, electronic map overlays.

Recommendation 2.4

Working with ATSDR, EPA, CDC, and other organizations with direct responsibility for emergency preparedness and response, NLM should continue its research to improve access to information helpful for these organizations and local agencies in managing emergencies such as chemical spills. Other information sources that are shown to be useful in emergency situations should be added to ANSWER.

2.5 Support Information Access by Professionals Serving Underserved Populations

NLM has placed a high priority on outreach to health professionals in underserved communities, specifically with the purpose of improving access to

NLM information services. Environmental issues are of concern to underserved populations, including racial minorities and the socio-economically disadvantaged, who tend to be disproportionately exposed to hazardous environmental conditions at home and in the workplace.⁸

NLM has under way a program to enhance the capability of students and faculty at Historically Black Colleges and Universities (HBCUs) to use the toxicological, environmental, occupational, and hazardous waste information resources available from the NLM. HBCUs are the training ground for many of the health professionals who will ultimately practice in underserved communities. These institutions are also uniquely positioned to channel needed information to neighboring communities possibly affected by exposures to toxic chemicals and other hazardous materials. This information can be vital for purposes of prevention, diagnosis, treatment, and public awareness.

Recommendation 2.5

NLM's current outreach efforts to improve access to toxicological and environmental health information by health professionals working with underserved populations should be strengthened. NLM should continue to place special emphasis on efforts directed to minority health education institutions and the communities they serve.

2.6 Emphasize Service to Health Professionals

NLM has a long-standing policy of focusing its products and services on the needs of health professionals rather than the general public. A primary reason for this is the near-impossibility of acquiring, organizing, and making accessible the huge volume of publications prepared for use by the lay public with the resources even remotely foreseen for the Library. The NLM Board of Regents has stated, "While the distinction between health education for the public and education for the health professional is not absolutely clear, the prime responsibility of the NLM is the organization and dissemination of knowledge which has applicability to the needs of health professionals. The statutory responsibility for health education for the public resides in other Federal agencies."⁹

In its 1987 Long Range Plan¹⁰, the Board re-examined this issue and recommended that NLM study current sources of health information for the public and the potential role for NLM in this area. It also recommended that NLM augment DIRLINE—an NLM online directory of information-providing organizations—to provide a more complete directory of sources of health information for the lay public. NLM has expanded DIRLINE coverage as recommended. Regrettably, this task has become more difficult for NLM, since the Library of Congress stopped maintaining the National Referral Center database, which had constituted the core of DIRLINE. Because of the daunting investment that would be needed to collect and organize the huge body of



published health information for the public, NLM has not initiated efforts in this area beyond expanding DIRLINE.

The Toxic Chemical Release Inventory (TRI) presents a special case. TRI, which contains data on the releases of over 300 toxic chemicals into the air, water, and land, is used largely by emergency personnel and environmental organizations. The Environmental Protection Agency, however, is required to provide the TRI data to the general population and has entered into an interagency agreement with NLM to make the data available through TOXNET. NLM is working to provide a clear and easy-to-use interface to TRI for lay and professional users.

From the Baltic to the Black Sea, half a century of runaway industrialization has left a smear of destruction through the heart of Eastern Europe.¹¹ (National Geographic)

Recommendation 2.6

NLM should continue its historical emphasis on serving the information needs of professionals. While improved accessibility to NLM's databases should be established primarily for scientists and health officials, new access mechanisms for databases such as the Toxic Chemical Release Inventory (TRI) should be developed for the general public as well as professionals, and NLM should study the costs and benefits of such experiments.

2.7 Enhance Access to International Information Resources

A significant amount of the health-related information collected and disseminated by NLM comes from abroad. In 1879, when the Library published the first issue of *Index Medicus* (IM), 530 of

the 660 journals indexed in IM (80%) were from outside the U.S. Today, a significant amount of the information collected by NLM continues to come from non-U.S. sources—the comparable non-U.S. IM figure today is 63%—and much of the literature cited from U.S. sources derives from the work of international researchers.

Concerns about the environmental effects on human health are global, and not confined to the U.S. Chemicals are produced, traded, and used throughout the world in increasingly large numbers and quantities. Once released into the environment, they may be transported deliberately or inadvertently across wide distances by air or water or in food. They may be accumulated or transformed in plants, animals, and humans. Thus, environmental chemicals pay no attention to national boundaries. Some, such as those causing atmospheric changes, may affect human health globally in different ways and to different degrees in many countries for many years. In addition to global phenomena, each country or region will have data on the effects that are most prominent there.

NLM is in a position to offer substantial technical assistance to countries endeavoring to improve their health and environmental databases. In its ongoing international program, the Library now provides technical support to some countries seeking to develop regional or national biomedical information systems. If resources permit, NLM should consider taking a more systematic and active role in providing both information and technical assistance to more countries.



Obviously, information from around the world is important to reducing health risks to American citizens resulting from contamination of the environment. The need for international data sharing has never been more important. The globalization of the economy and of science and technology is bringing into sharper relief the importance of international data in toxicology and environmental health for U.S. research and development, academic instruction and curriculum development, and development of the scientific foundations for public health policy and health services.

There is intensified research in this area, particularly in industrialized countries. In addition, many governments have adopted laws controlling chemical risks. These laws for the testing and risk assessment of chemical substances and industrial facilities are often similar to U.S. laws, and are providing a basis for many specialized databases. International and regional efforts in these areas that should be considered for collaboration with NLM are the United Nations Environmental Programme (UNEP) International Register of Potentially Toxic Chemicals (IRPTC), the joint ILO/UNEP/WHO International Programme on Chemical Safety (IPCS), OECD's Chemicals Programme, and relevant activities of the European Community (EC).

NLM cannot afford to ignore the intellectual, informational, or financial resources represented by these activities in other countries. It is important to have access to these databases to avoid costly and unnecessary duplication of effort, and to allow health professionals and researchers in the United States to benefit from the worldwide growth in understanding about toxicology and environmental health problems.

Recommendation 2.7

NLM should systematically review international sources of relevant information and establish formal links with organizations whose databases would contribute to NLM's main goals in toxicology and environmental health. The review should pay special attention to the sources of information that may become available in Eastern Europe and Asia. NLM should collaborate with international programs in toxicology and environmental health such as those operated by the UN and its specialized agencies, the OECD, and the European Community, with the goal of facilitating access to these information resources by U.S. users. When resources permit, NLM should also offer technical assistance to countries endeavoring to improve their health and environmental databases.

To advance a society's health goal ... depends on optimizing the environmental determinants of health...The quality of decisions ... depends on the proper communication of accurate information to decision-makers, public and private, entrepreneurial and domestic.¹² (World Health Organization)
